LADEE Mission

Level 2 Functional Requirements Document

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Document Custodian: Date
Payload Engineer

Approved by: Date
Principal Investigator
Goddard Space Flight Center

Approved by: Date
Payload Manager

Approved by: [TBS] Date
[Title - TBS]

Approved by: [TBS] Date
[Title - TBS]

Approved by: [TBS] Date
[Title - TBS]

Approved by: [TBS] Date
[Title - TBS]

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National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

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Instrument Functional Requirements Document
CHANGE LOG

Date	Revision	Changes
	DRAFT	

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1.0 Purpose

The Instrument Functional Requirements Document (FRD) provides an accurate functional description of the Investigation Hardware and Software at the Instrument level, as well as at the Instrument subsystem level. This description is the basis of descriptions of the Instrument System that will be used in other LADEE Project documents. The FRD establishes the <instrument name> technical functional requirements in the form of verifiable and validatable "shall" statements.

FRD requirements are traceable to the investigation described in the <instrument name> selection letter and to the LADEE Project Science Requirements Document (SRD). Requirements defined in the I-FRD that will be carried by the LADEE Project as investigation success criteria shall be identified by (sc) following the relevant "shall" statement.

The functional requirements specified in this document will form the basis of a verification matrix that will be used to establish that the as-built instrument will be capable of supporting the investigation specified in the SRD.

[NOTE: It is expected that the first draft of this document will be created largely from text and figures drawn from the investigation proposal package.]

The requirements contained in this document define the capabilities and acceptable performance of LADEE's <instrument name>. These requirements will directly or indirectly influence all technical aspects related to the development of the flight <instrument name> instrument and flight software and include, but are not limited to, design, analysis, interfaces, generation of lower level requirements, implementation, inspection, test, verification and validation (V&V).

A V&V matrix is included in this document as Appendix B. Requirements controlling non-technical aspects of <instrument name>, the development of support equipment and data processing systems, and the development of mission operations and data analysis systems will be captured elsewhere, but in no case will they conflict with the requirements herein.

1.1 Scope

This document establishes the technical requirements for the <instrument name> instrument. The scope and approach is based on the preliminary information contained in the PIs proposal and the terms of the selection letter sent as a result of the NASA Announcement of Opportunity proposal evaluation and selection process.

The I-FRD is the technical basis document for the programmatic planning described in the Experiment Implementation Plan (EIP). The Scope of Work and Implementation Management for the Investigation described in the EIP shall be consistent with the I-FRD.

1.2 Document Organization

[TBS]

1.3 Configuration Management

[TBS]

2.0 Applicable Documents

2.1 Requirements Source Documents

The following list summarizes the requirements source documents applicable to the <instrument name>. The information in the documents listed below is controlling over the instrument Level 4 requirements contained herein.

Requirements Source Document	Document ID	WEB Location
<instrument name> Interface Requirements Document (IRD)	[TBS]	[TBS]
<instrument name> Science Requirements Document (SRD)		

2.2 Other References

[TBS]

2.3 Requirement Target Documents

The following list summarizes the requirements target documents applicable to the <instrument name>. The information in the documents listed below conforms to, and flows from the instrument Level 4 requirements contained herein.

Requirements Target Document	Document ID	WEB Location
Science Instrument V&V Matrix	[TBS]	[TBS]
Mechanical Interface Control Drawing	[TBS]	[TBS]
Instrument Interface Requirements Document	[TBS]	[TBS]
Instrument Interface Control Document	[TBS]	[TBS]
	[TBS]	[TBS]

3.0 Functional Description

3.1 Instrument Functional Description

The information in Section 3.1 is descriptive, providing context for the requirements specified in the subsequent sections. <instrument name> is a ... [provide thumbnail description].

3.1.1 General Science

This section provides an overview description of the science investigation.

3.1.2 Basic Measurement Description

This section provides an overview description of the basics measurements to be accomplished in support of the science investigation.

3.1.3 Major Subsystem Descriptions

This section provides descriptions of the instrument's major subsystems.

The <instrument name> structure consists .... The electronics ....

Figure 3-1 shows a schematic of the mechanical configuration of the instrument with the major components indicated. Figure 3-2 gives a schematic representation of the [critical subsystem] layout, and a functional block diagram is provided in Figure 3-3.

[INSERT FIGURE HERE]
Figure 3-1. <instrument name> Mechanical Configuration

[INSERT FIGURE HERE]
Figure 3-2. <instrument name> [Critical Subsystem, e.g., Optical] Layout

[INSERT FIGURE HERE]
Figure 3-3. <instrument name> Electronics Functional Block Diagram

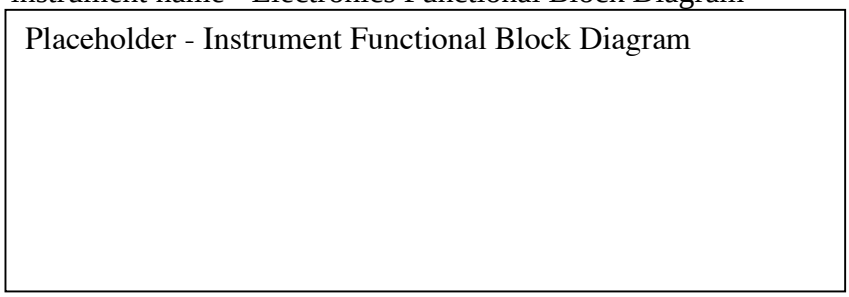

figure 3.1 Instrument Block Diagram

3.2 General Operational Approach: Modes and Operating Strategy

Operations modes, durations, operations strategies required to fulfill the science requirements, strategies to maximize useful data return, etc.

4.0 Instrument Requirements

Instrument functional requirements are defined in this section. Investigation success criteria are covered separately in Section 6. Requirements identified in Section 4 that are also investigation success criteria are identified by (sc) following the relevant "shall" statement. [NOTE: Instrument functional requirements typically include some margin on the performance required for investigation success, thus the number of success criteria identified in Section 4 may be small.]

4.1 General Resource Allocation Requirements

[This section addresses implementation constraints imposed by the flight system. Details of these items are specified in the Instrument Interface Requirements Document/Interface Control Documents.]

The total mass of the <instrument name> instrument shall not exceed [TBS] kg, or the value specified in the <instrument name> Interface Requirements Document, whichever is greater.

The total power consumption of the <instrument name> instrument shall not exceed [TBS] watts average, [TBS] watts peak, or the average and peak values specified in the <instrument name> Interface Requirements Document, whichever are greater.

The enveloped volume required by the <instrument name> instrument, inclusive of any instrument specific keep-out zones, shall lie within [SPECIFY BULK DIMENSIONS]. Details of this volume are specified in the <instrument name> Interface Requirements Document.

Grounding and interfacing shall be implemented in the electrical and mechanical design to minimize susceptibility to EMI, as described in the <instrument name> Interface Requirements Document.

General Power & Data Interface Statement: Voltages from spacecraft, data buses, etc.

The <instrument name> instrument and all of its sub-systems shall be compatible with the requirements of the LADEE Environmental Requirements Document, as described in the <instrument name> Interface Requirements Document.

4.2 Instrument Performance Requirements

4.2.2 [Instrument-specific Performance Parameter_1] Performance Requirements

[Sections 4.2.2 through 4.2.x are reserved for Instrument-specific performance parameters, for example Spectral Performance, Field-of-View (FOV) Performance, Radiometric Performance]

4.2.3 [Instrument-specific Performance Parameter_2] Performance Requirements

[Sections 4.2.2 through 4.2.x are reserved for Instrument-specific performance parameters, for example Spectral Performance, Field-of-View (FOV) Performance, Radiometric Performance]

4.2.4 [Instrument-specific Performance Parameter_2 Requirements

[Sections 4.2.2 through 4.2.x are reserved for Instrument-specific performance parameters, for example Spectral Performance, Field-of-View (FOV) Performance, Radiometric Performance]

4.3 Major Functional Elements

For the purpose of defining instrument functional requirements, <instrument name> shall consist of the following major functional elements [modify list as appropriate]:

(a) Structure & Mechanisms (4.4)
(b) Electronics (4.5)
(c) Software (4.6)
(d) Thermal (4.7)
(e) [Instrument specific functional element, e.g., Optics and Targets] (4.8)
(f) [Instrument specific functional element, e.g., Focal Planes] (4.9)

4.4 Structure and Mechanisms Requirements

[TBS]

4.4.1 Major Functional Elements

The <instrument name> structure and mechanisms shall consist of the [TBS].

4.4.2 Structural Element 1

[TBS - Sections 4.4.2 through 4.2.x are reserved for Instrument-specific Structural Elements]

4.4.3 Structural Element 2

[TBS - Sections 4.4.2 through 4.2.x are reserved for Instrument-specific Structural Elements]

4.4.x Structural Element [x]

[TBS - Sections 4.4.2 through 4.2.x are reserved for Instrument-specific Structural Elements]

4.5 Electronics Requirements

Subsections 4.5.6 through 4.5.x may be tailored to specific instrument requirements. Possible section headings may include, for example: Focal Plane Interface, Analog Heater Control, Housekeeping, Actuator Control, Digital Controller.

4.5.1 Major Functional Elements

4.5.2 Power Supplies / Converters

4.5.3 S/C Interface

4.5.4 Cabling

4.5.5 Firmware

4.5.6 [TBS]

4.5.x [TBS]

4.6 Software Requirements

Sections 4.6.2 through 4.6.x may be tailored to specific instrument requirements. Possible section headings may include, for example: Command and Housekeeping Handler, Observation Sequence Tables, Spacecraft Interface, Actuator Positioning, Science Data Processing, Science and Housekeeping Sensor Interface.

4.6.1 General Requirements

4.6.2 [TBS - see above note]

4.6.x [TBS - see above note]

4.7 Thermal Requirements

This section provides and discusses the instrument's thermal requirements. This document addresses only those requirements that are on the instrument side of the spacecraft/instrument interface.

4.7.1 General Requirements

<instrument name> shall be designed to survive a non-operating temperature

4.8 [Instrument specific functional element, e.g., Optics and Target] Requirements

[TBS Sections 4.8.2 through 4.8.x may be tailored to specific instrument requirements.]

4.8.1 Major Functional Elements / General Requirements

[TBS]

4.8.2 Element 1

[TBS]

4.8.3 Element 2

[TBS]

4.8.x Element 3 - more complex subsystem

[TBS]

4.9 [Instrument specific functional element, e.g., Focal Plane Requirements]

[TBS Sections 4.9.2 through 4.9.x may be tailored to specific instrument requirements.]

4.9.1 Major Functional Elements / General Requirements

[TBS]

4.9.2 Element 1

[TBS]

4.9.3 Element 2

[TBS]

4.9.x Element [x]

[TBS]

5.0 Interface Definition

[This section will consist of pointers to other documents (ICDs)]

6.0 Instrument Success Criteria

Instrument Investigation Success criteria are listed in this section. The Instrument Investigation success criteria are performance and functional items to be achieved during the Lunar Orbit Operations phase of the LADEE mission.

7.0 Special Requirements & Assumptions

[TBS, e.g., This section is optional and can be used to address instrument-specific requirements that do not fit into the provided format. Additionally, this section can be used to identify any underlying assumptions not previously addressed that may be integral to the requirements specified in this document.]

Appendix A: Abbreviations and Acronyms